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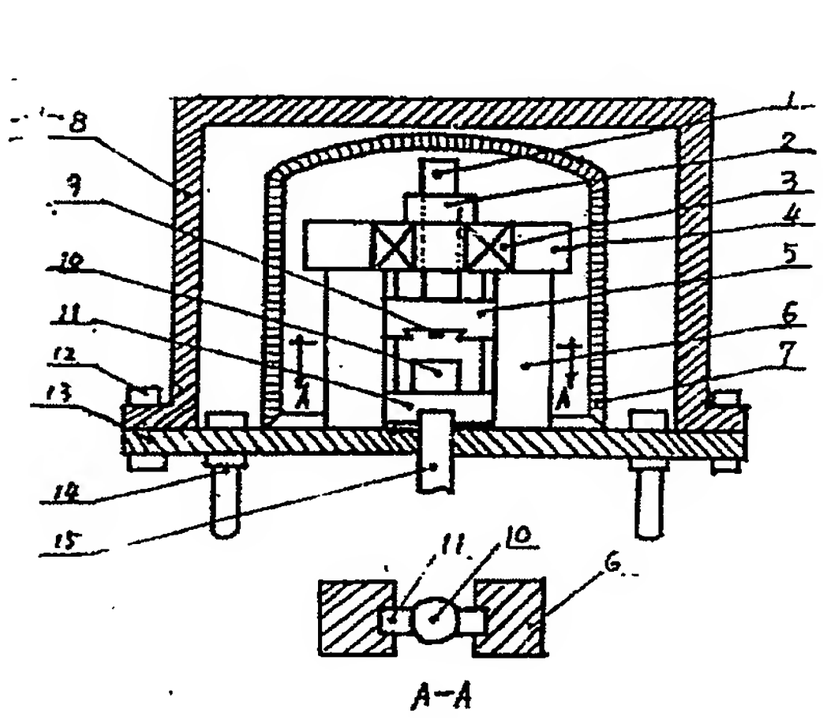
[54]实用新型名称 霍尔膨胀仪

[57]摘要

一种依靠电磁转换原理测量材料伸长度的膨胀仪。该仪器的检测系统是由装有霍尔元件的固定装置、装有磁铁并可在一维方向自由滑动的膨胀传动装置以及热屏蔽装置等部分构成，仪器精度可达 10^{-7}—10^{-9}/℃，造价约五千元，测量一次只用 3—5 小时左右，具有高精度、低成本和节约测量时间等优点。



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权　利　要　求　书

1．一种依靠电磁转换原理制成的膨胀仪，其特征在于膨胀仪的检测系统是由霍尔元件、磁铁、上滑块、下滑块、螺栓与螺母、轴承、支架、导杆、热屏蔽装置、底板等构成，其中霍尔元件固定在上滑块上，上滑块与螺栓相固结，轴承的外套固结在支架的横梁中央，和上滑块相固结的螺栓在轴承中穿过，并通过螺母将其固定在轴承的内套上，支架两立梁上留有供上、下两滑块在其上面自由滑动的导轨，磁铁固定在下滑块上，与下滑块相固结的导杆从底板中穿过，热屏蔽装置与底板构成一封闭系统。

说　　明　　书

霍尔膨胀仪

本发明为一种依靠电磁转换原理制成的测量材料膨胀特性的仪器。

众所周知，利用电磁转换的方法制成的膨胀仪早已问世。例如差动变压器式膨胀仪就是一例。然而这类仪器的精度通常不高，一般在 10^{-4}/C 左右，这已经不能满足对于材料精密测量的要求；若使其精度进一步提高，则要有许多补救措施作保证，结果变得复杂化，操作起来也不方便。目前普遍使用的高精度膨胀仪一般都是依近代先近技术如“激光”、“电子衍射”等制成，一般可达 10^{-6} — 10^{-7}／℃的精度，可带之而来的是仪器制造成本成几倍至几十倍的增长；测量时间长；对于试样的形状要求的比较严格，这是目前已有技术中普遍存在的又一缺点，例如用激光式膨胀仪或电子衍射式膨胀仪进行测量，则要将试样加工成直径为 10 毫米、长为 100 毫米的管状体；对于某些材料来说，是不易作到。有些仪器测量一个试样的膨胀度需要几天的时间，费时过长。

本发明的目的在于设计并制造出一种造价低、精度高、操作简便的新型膨胀仪。经反复构思多次实验已得到能够满足上述发明目的仪器——霍尔膨胀仪。

霍尔膨胀仪仍依靠电磁转换原理制成，其特征在于仪器的检测系统是由装有霍尔元件的固定装置，可在一维方向自由滑动的膨胀传动装置以及热屏蔽装置等三部分构成。附图是该仪器检测部分的结构示意图及 A—A 剖面图。其各组成部件分别为：螺栓 1、螺母 2、轴承 3、横梁 4、上滑块 5、立梁 6、热屏蔽 7、外壳 8、霍尔元件 9、磁铁 10、下滑块 11、外壳固定螺钉 12、底板 13、支撑柱 14、导杆 15。

前面所说的装有霍尔元件的固定装置指的是由霍尔元件9、上滑块5、螺栓1、螺母2、立梁6、轴承3和横梁4组成的结构。各部件间是这样配合的：霍尔元件固定在上滑块上。上滑块与螺栓相固接，螺栓通过螺母将其固定在支架上。支架指的是横梁和立梁。其中，支架的立梁与横梁相固结。立梁上设有导轨。横梁上边有轴承。轴承装在横梁的中间。轴承的外套与横梁相固结。螺栓从轴承中间通过。通过螺母将其固定在轴承的内套上。由“固定部分”的上述结构可知，这里的“固定”仅对于支架、轴承等而言是固定的，而对于上滑块及螺栓而言的固定是相对的。因为螺栓及其连接部分是可调的。为了适应试样长度不同等要求，可以转动螺母，使之通过上滑块将霍尔元件升高或者降低。以保证在测量时霍尔元件与磁铁之间仍然保持最佳距离，维持最高的灵敏度。轴承是为了降低摩擦，实现螺母对螺栓的调节功能设置的。螺母和轴承内套相固定。当转动螺母时，轴承内套和螺母一起转动，而轴承外套和横梁之间一直相对静止。

前面所说的可在一维方向自由滑动的膨胀传动装置指的是由磁铁10、下滑块11和导杆15组成的结构。其中磁铁固定在下滑块上，下滑块与导杆相固结，导杆从底板中间穿过，通过石英杆与试样相接触。

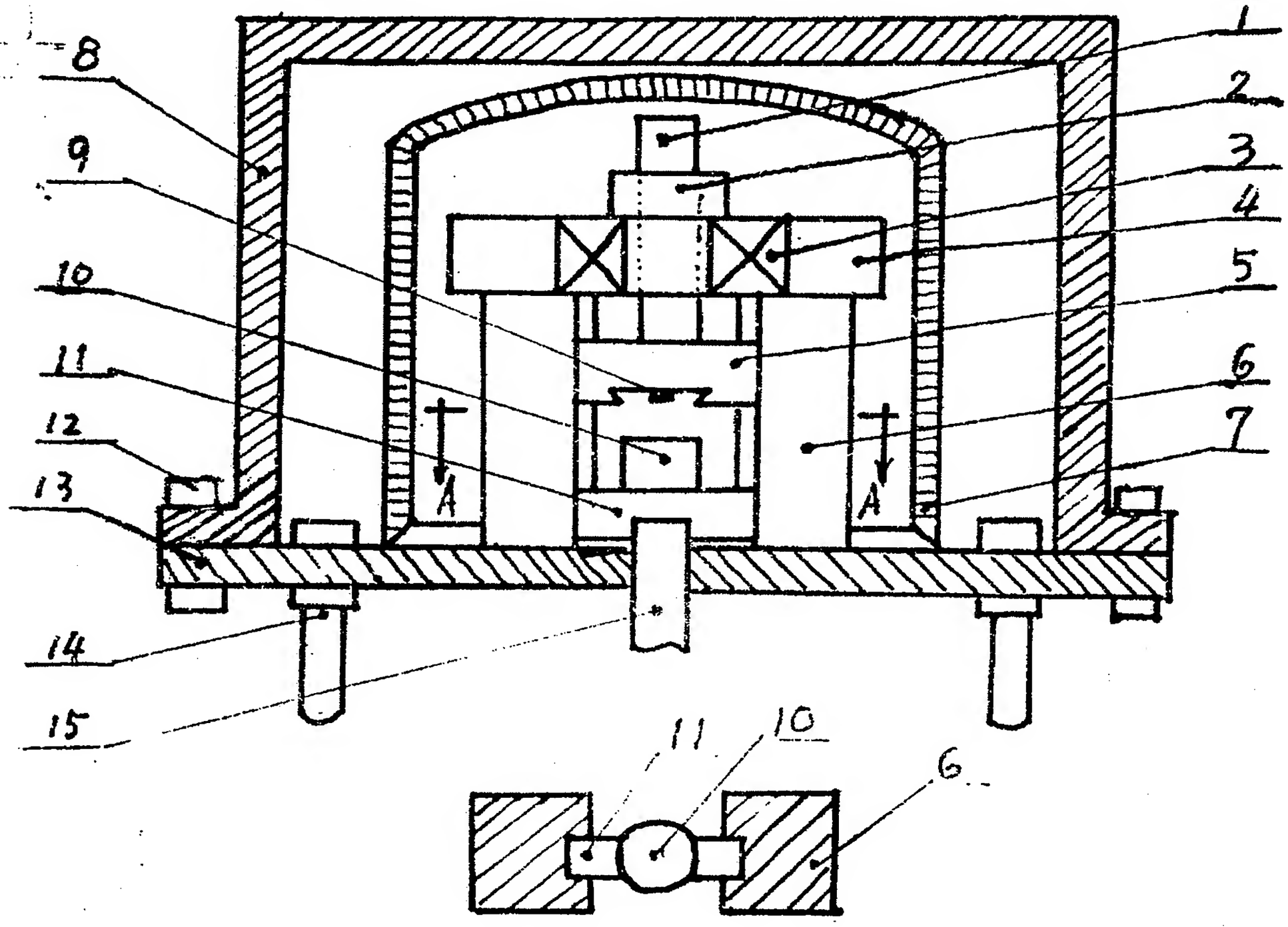
为了保证检测部分所获得的信号具有足够的精度，要求霍尔元件和磁铁间的相对运动只能允许一个自由度，即两者间的距离只能严格地在一维方向上发生变化。上下两滑块在导轨上的滑动即可实现上述要求。为了保证仪器的精度要求，导轨与滑块间特别是导轨与下滑块间的配合要特别好，一方面要紧密以保证其一维性，另一方面又要尽量减少摩擦以降低试样膨胀时所受到的摩擦力的影响。

检测系统的热屏蔽装置应能将整个固定装置和滑动装置都罩起来，和底板构成一封闭系统。其材料可以采用杜瓦瓶（保温瓶胆），也可以是其它的绝热材料。因为检测系统的材料也将受到温度的影响而发生热膨胀现

象。可能产生测量误差。安装热屏蔽的目的就在于尽量使检测系统处于绝热封闭状态。免受环境因素的影响。

用上述方法实现的膨胀仪，其原理是：当试样因温度变化而发生线性膨胀或收缩时，通过导杆15传感，带动下滑块11，使下滑块11上的磁铁10.与上滑块5上的霍尔元件9的相对位置发生变化，从而使得霍尔元件的霍尔电压亦发生变化。测量出这个变化值，并加以处理与显示，即可达到测量材料膨胀特性的目的。

本项发明已实施，所做出的霍尔膨胀仪的结构和附图基本相同。仪器试样的放置无特征之处，操作方法亦无需特殊之规定。试制出的霍尔膨胀仪的精度为 10^{-7}—10^{-9}/℃，价格在4—5千元人民币/台，测试一次的时间约为3—5小时，对于试样形状的限制不大，若棒状试样，其直径3—5毫米，长50毫米即可；管状、丝状或方、扁、圆型都行。



A—A

Hall Dilatometer

The objective of the present invention is to design and manufacture a new dilatometer which has low cost, high precision and easy operation. A device, Hall dilatometer, which can meet the above objective, has already obtained after many experiments.

The Hall dilatometer is based on electromagnetic transduction principle, and is characterized in that a detection system of the dilatometer comprises: a fixed apparatus housing a Hall element, a dilation transmission apparatus sliding freely in a direction of one dimension, and a heat shield apparatus. The figure is a structural schematic diagram of the detection system and A-A section thereof. The components are: a bolt 1; a nut 2; a bearing 3; a cross girder 4; an upper sliding block 5; an upright girder 6; a heat shield 7; a case 8; a Hall element 9; a magnet 10; a lower sliding block 11; a screw 12 for fixing the case; a plate 13; a supporting role 14; and a guide rod 15.

The above fixing apparatus housing the Hall element is a structure comprising the Hall element 9, the upper sliding block 5, the bolt 1, the nut 2, the upright girder 6, the bearing 3 and the cross girder 4. The Hall element 9 is fixed on the upper sliding block 5 which is fixed to the bolt 1, and the bolt 1 is fixed on the frame which include the cross girder 4 and the upright girder 6 by the nut 2. The upright girder 6 and the cross girder 4 are connected to each other. The guide rod 15 is positioned on the upright girder 6, and the bearing 3 is positioned on the cross girder 4 and in the center of the cross girder 4. The casing of the bearing 3 is fixed to the cross girder 4. The bolt 1 passes through the middle of the bearing 3 and is fixed to the lining of the bearing 3 by the nut 2. It can be seen from the structure of the fixing apparatus that the "fix" here means be directly fixed to the frame, bearing and etc., and be relatively fixed with respect to the upper sliding block 5 and the bolt 1 because the bolt 1 and its connection part can be adjustable. In order to adapt to requirements such as different sample lengths, the nut 2 can be turned such that the Hall element 9 can be raised or lowered by the upper sliding block 5, so as to ensure that there is still optimal distance between the Hall element 9 and the magnet 10 and achieve the highest sensitivity. The bearing 3 is used to decrease friction to implement adjustment to the bolt 1 by the nut 2. The nut 2 is fixed to the lining of the bearing 3. When the nut 2 is turned, the lining of the bearing 3 is turned together with the nut

2. The casing of the bearing 3 is still with respect to the cross girder 4.

The above mentioned dilation transmission apparatus sliding freely in a direction of one dimension is composed of the magnet 10, the lower sliding block 11 and the guide rod 15. The magnet 10 is fixed on the lower sliding block 11 which is connected to the guide rod 15. The guide rod 15 passes through the middle of the plate 13 and contacts with the sample through a quartz rod.

In order to ensure that the signal obtained by the detection system has enough precision, it is required that the relative movement between the Hall element 9 and the magnet 10 only can have one dimension, i.e. the distance between them can be changed only in the direction of one dimension. The slide of the upper and lower sliding blocks on the guide rod can implement above requirement. In order to ensure the precision of the dilatometer, the match between the guide rod and the sliding blocks, especially between the guide rod and the lower sliding block must be very fine. From one aspect, the match must be tight to ensure one dimension. On the other hand, the friction between the guide rod and the sliding blocks would be decreased as much as possible to reduce the effect of the friction force caused by the dilated sample.

The heat shield apparatus of the detection system should cover all the fixing apparatus and the transmission apparatus, and constitutes a closed system with the plate 13. The material of the heat shield apparatus can use Dewar vessel (thermos container) or other adiabatic materials. The material of the detection system could be heat dilated by the temperature and thus the measure error would be generated. The purpose of the heat shield is to make the detection system in the adiabatic closed state to be avoided from effect of the environmental factors.

The principle of the dilatometer is that when the sample is linearly dilated or shrinked, the guide rod 15 can sense it and enable the lower sliding block 11 to slide. The position of the magnet 10 on the lower sliding block 11 is changed with respect to the Hall element 9 on the upper sliding block 5. Thus the Hall voltage of the Hall element is also changed. The changed voltage is measured, processed and displayed. By this way, the dilation property of the material can be measured.